

Deep Learning has emerged as one of the most successful fields of machine learning and artificial intelligence with overwhelming success in industrial speech, language and vision benchmarks. Consequently it became the central field of research for IT giants like Google, Facebook, Microsoft, Baidu, and Amazon. Deep Learning is founded on novel neural network techniques, the recent availability of very fast computers, and massive data sets. In its core, Deep Learning discovers multiple levels of abstract representations of the input. The main obstacle to learning deep neural networks is the vanishing gradient problem. The vanishing gradient impedes credit assignment to the first layers of a deep network or early elements of a sequence, therefore limits model selection. Most major advances in Deep Learning can be related to avoiding the vanishing gradient like unsupervised stacking, ReLUs, residual networks, highway networks, and LSTM networks. Currently, LSTM recurrent neural networks exhibit overwhelmingly successes in different AI fields like speech, language, and text analysis. LSTM is used in Google's translate and speech recognizer, Apple's iOS 10, Facebook's translate, and Amazon's Alexa. We use LSTM in collaboration with Zalando and Bayer, e.g. to analyze blogs and twitter news related to fashion and health. In the AUDI Deep Learning Center, which I am heading, and with NVIDIA we apply Deep Learning to advance autonomous driving. In collaboration with Infineon we use Deep Learning for perception tasks, e.g. based on radar sensors. With Deep Learning we won the NIH Tox21 challenge and deploy it to toxicity and target prediction in collaboration with pharma companies like Janssen, Merck, Novartis, AstraZeneca, GSK, Bayer together with hardware-related companies like Intel, HP, Infineon, NVIDIA and others.